AOIT Computer Networking

Lesson 2

Introduction to Networking

Teacher Resources

| Resource | Description |
| --- | --- |
| Teacher Resource 2.1 | Presentation and Notes: Analog and Digital Signals (includes separate PowerPoint file) |
| Teacher Resource 2.2 | Posters: Circuit-Switched vs. Packet-Switched Networks (separate PDF file) |
| Teacher Resource 2.3 | Answer Key: Comparing Circuit- and Packet-Switched Networks |
| Teacher Resource 2.4 | Quiz: Introduction to Networking |
| Teacher Resource 2.5 | Answer Key: Introduction to Networking Quiz |
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Teacher Resource 2.1

Presentation Notes: Analog and Digital Signals

Before you show this presentation, use the text accompanying each slide to develop presentation notes. Writing the notes yourself enables you to approach the subject matter in a way that is comfortable to you and engaging for your students. Make this presentation as interactive as possible by stopping frequently to ask questions and encourage class discussion.

|  |  |
| --- | --- |
| Description: C:\Users\Mika\Documents\My Documents\Pearson\2012\June\6\Networking_Lesson2_Presentation_ROOT_060412\Slide1.JPG  This presentation describes the physical qualities of analog and digital signals and how those signals are used in communications networks. | Presentation notes |
| Description: C:\Users\Mika\Documents\My Documents\Pearson\2012\June\6\Networking_Lesson2_Presentation_ROOT_060412\Slide2.JPG  Do you know which is the analog and which is the digital signal?  Here’s a clue to help you think about the differences between the two types of signals: an analog signal is continuous; a digital signal is either on or off. | Presentation notes |
| Description: C:\Users\Mika\Documents\My Documents\Pearson\2012\June\6\Networking_Lesson2_Presentation_ROOT_060412\Slide3.JPG  This graph shows the square waveforms used by digital networks. The ups and downs in the waveform show changes in frequency. Can you see how the spacing between the high and low spots is different as the wave travels from left to right? This shows how the frequency changes over time and how this might be interpreted into binary—one and zero, on or off.  Computer systems use binary code to communicate. Ones and zeros are strung together to form instructions to the computer. Computer networks use electric pulses across wire to communicate. The pulses travel with less static and interference than analog signals, which tend to degrade more across longer distances.  In and of itself, a digital signal means nothing, but we can assign different meanings to it. We just need to make sure that the computers reading the signal know how to properly interpret it. | Presentation notes |
| Description: C:\Users\Mika\Documents\My Documents\Pearson\2012\June\6\Networking_Lesson2_Presentation_ROOT_060412\Slide4.JPG  The sound of the human voice is an example of an analog signal. So, what makes it different from a digital signal?  An analog signal is a wave pattern that is continuously variable.  In the world around us, all sounds are actually analog sounds. Everything we perceive has a gradual change over time. Examples of analog signals include sound and light waves. Audio tape cassettes are analog; CDs and DVDs are digital.  Early cell phone systems used analog radio waves to transmit voice signals, so they were analog.  Second-generation (2G) and later cell phones are digital. They use the same radio technology as the early analog cell phones, but the digital signal is compressed in a way that analog signals cannot be. Digital cell phones compress your voice into binary information. Because they can be compressed, digital signals allow more channels to fit in a given bandwidth. | Presentation notes |
| Description: C:\Users\Mika\Documents\My Documents\Pearson\2012\June\6\Networking_Lesson2_Presentation_ROOT_060412\Slide5.JPG  Modems are used to connect computers to the Internet via analog phone lines. The word *modem* is short for MOdulate and DEModulate, because this is what a modem must do in order to connect the digital to an analog signal.  When a user connects to the Internet on a telephone wire, the binary code is modulated and transformed to an analog one via a modem; it is then demodulated—or translated back to binary—at the other end.  ASCII is the system we use to translate the alphabets we type on a computer into the computer’s native binary language. Our full, rich alphabets of 26 letters, 10 numbers, and all the other symbols we use (such as punctuation) are too complicated for the computer, since it uses only electric pulses to communicate. So, ASCII translates the symbols into something the computer can understand within its binary structure. | Presentation notes |
| Description: C:\Users\Mika\Documents\My Documents\Pearson\2012\June\6\Networking_Lesson2_Presentation_ROOT_060412\Slide6.JPG  The first computer networks relied on analog telephone lines to connect. Since the computer spoke in binary but the phone lines used only analog signals, the computer was connected to a modem, which translated the message into an analog signal. On the other end, the analog signal coming from the telephone line was converted back to a digital one so that the other computer could read it.  Today, most people use cable or DSL—digital lines—to connect to the Internet, which is a purely digital network.  DSL service uses a DSL modem to connect your computer to your public telephone service.  Cable service uses the cable TV infrastructure to bring an Internet connection to your home, school, or office. Cable companies that provide Internet service require you to use a cable modem to connect your computer to the Internet.  Some Internet service providers offer voice over Internet Protocol (VoIP) technology, which uses a modem that separates voice information from data. With VoIP, you don’t need a land line. Some telephone companies do not offer DSL service without telephone line service, although more companies are beginning to unbundle their DSL and phone services. Currently, VoIP is more popular with cable modem users. | Presentation notes |

Teacher Resource 2.3

Answer Key:   
Comparing Circuit- and Packet-Switched Networks

This answer key accompanies Student Resource 2.4, Interactive Reading: Comparing Circuit- and Packet-Switched Networks.

|  | Circuit-Switched Networks | Packet-Switched Networks |
| --- | --- | --- |
| **Signal Type** | Analog | Digital |
| **Type of Wiring and Connection** | Copper wire is used, and a direct, exclusive, analog connection is established for the duration | Data is broken into packets, and many calls or queries can be sent at the same time; copper wire can be used, as can fiber-optic cable |
| **Advantages** | Speed of communications; reliability; better than previous networks | Efficiency; versatility; geographically distributed communications; can be as large as needed; new technologies improving speed |
| **Disadvantages** | Needs special equipment; only one connection per line | Many connections per line; multimedia can be slow or lossy |

Summarize IP and ATM Similarities and Differences

|  | Internet Protocol (IP) | Asynchronous Transfer Mode (ATM) |
| --- | --- | --- |
| **Size of Packets** | Variable-sized cells | Fixed-sized cells |
| **Connection Type** | No ongoing connection | Connects before transfer |
| **What Routes Do Packets Travel?** | Packets take many routes | Packets go directly to the other side |
| **Benefits** | Network can be as large as needed; system won’t break if one section goes down; quality of service for multimedia applications is improving | Speedy; good for multimedia; predictable; easy to track data |
| **Disadvantages** | Quality of service has traditionally been questionable for multimedia | Requires special devices; if one point fails, the connection goes down |

Teacher Resource 2.4

Quiz: Introduction to Networking

Student Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date:\_\_\_\_\_\_\_\_\_\_\_

1. What are the differences between analog and digital signals? Draw a waveform that represents each.
2. Draw and label a diagram of a long-distance telephone network. Include labels for what kind of wires are used, what signals go across the wires, and what devices are needed for the network to operate.
3. Describe two essential differences between the two types of packet-switched networks we learned about: Asynchronous Transfer Mode and Internet Protocol.
4. What are two major advantages of IP technology, compared to the other kinds of networks we discussed?

Teacher Resource 2.5

Answer Key: Introduction to Networking Quiz

1. What are the differences between analog and digital signals? Draw a waveform that represents each.

Analog signals are continuous wavelength signals such as a sine wave. Analog signals occur naturally; digital signals are symbols that represent messages or alphabets. Digital signals use a binary system, forming a square wave.

1. Draw and label a diagram of a long-distance telephone network. Include labels for what kind of wires are used, what signals go across the wires, and what devices are needed for the network to operate.

Diagram should include copper wire with analog signal leading from telephone to main switchboard, a long-distance fiber-optic cable (digital signal), and copper wire leading to the other phone on the other side.

1. Describe two essential differences between the two types of packet-switched networks we learned about: Asynchronous Transfer Mode and Internet Protocol.

ATM sets up a connection prior to the transfer of data and uses the same connection for the duration of the transmission, while IP may use many routes and does not establish any kind of dedicated connection. ATM requires special devices for transmission, and IP uses basic network infrastructure. ATM uses fixed-sized packets and IP variable-sized packets. If part of the ATM network breaks, the entire network crashes; IP is independent of any particular node.

1. What are two major advantages of IP technology, compared to the other kinds of networks we discussed?

The network doesn’t break up if one node crashes. It is also easily expanded by adding more computers. Packets can take the quickest route through the network.

Teacher Resource 2.6

Key Vocabulary: Introduction to Networking

These are terms to be introduced or reinforced in this lesson.

| Term | Definition |
| --- | --- |
| AM (amplitude modulation) | A type of radio signal in which the amplitude, or strength, of a [radio wave](http://dictionary.reference.com/browse/radio%20wave) is varied to carry information from a transmitter to a receiver. |
| analog | A continuously variable signal or wave that can be modulated by frequency, amplitude, or phase. |
| asynchronous transfer mode (ATM) | A packet-switching method that bundles data into fixed-sized packets and maintains a connection between computers while transmitting data. |
| digital | A binary signal or wave that has only two properties, represented by a square waveform and representing communications such as computer networking or the telegraph. |
| discrete | Separate or distinct. Used to describe digital signals, which have two distinct states (on and off), as compared with the continuous sine waves that form an analog signal. |
| Internet Protocol (IP) | A packet-switching method that allows packets to be bundled in varying sizes and sent across different routes in the network, without establishing any connection between the two points. |
| lossy | Image compression technique that removes minor color variations. If the compression ratio is high, loss of detail is visible. |
| modem | A device for transmitting digital data over telephone wires by modulating the data into an audio signal to send it and demodulating the audio signal into data to receive it. |
| packet switching | A way of transmitting data digitally by breaking the initial message into smaller units, or *packets*, which are sent separately on the network and then reassembled at the destination. |
| packets | A short block of data transmitted in a packet-switching network. |
| phase shift | How far to the left or right an electromagnetic wave slides. |
| telegraph | The first large-scale digital communications network; used Morse code. |
| transmission | The act of sending a message; causing a message to be sent. |

Teacher Resource 2.7

Bibliography: Introduction to Networking

The following sources were used in the preparation of this lesson and may be useful to you as classroom resources. We check and update the URLs annually to ensure that they continue to be useful.

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